

PILOT PROJECT TO TEST THE
EFFECTIVENESS OF SEVIN INSECTICIDE
IN PREVENTING ATTACKS BY THE
MOUNTAIN PINE BEETLE IN LODGEPOLE PINE

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INTRODUCTION

The mountain pine beetle epidemic now existing in the Intermountain Region began in the early 1950's. Beetle populations and resultant tree killing were at their highest in the late 1960's. Though now on the decline Regionwide, the mountain pine beetle continues to kill thousands of lodgepole pine yearly in northern Utah, southeastern Idaho, and western Wyoming.

Annual control projects using EDB were begun in the Region in 1958. Failing to halt the beetle's advance, these projects were discontinued in 1970. Since that time, more emphasis has been placed on prevention than direct control.

In both 1975 and 1976, pilot projects were conducted on the Targhee National Forest, Idaho to evaluate the efficacy of Lindane, Sevin, and Dursban as preventive sprays against mountain pine beetle attacks in lodgepole pine (Klein, 1975, 1976). The 1975 application involved 2% oil-formulated mixtures of these chemicals. Resulting phytotoxicity attributed to the diesel oil carrier (Rogers, 1975) led to the 1976 project which evaluated the three insecticides in water-based formulations.

- The preventive spray project in 1976 was also conducted on the Targhee National Forest. The project was successful in that it demonstrated the feasibility of preventive sprays under near-operational conditions. It also provided the basis for a more refined pilot project to further evaluate Sevin against the recently established standard, Lindane (Gibson, 1977).

Purpose

The purpose of the present pilot project is to test the efficacy of Sevin insecticide applied as a 2% water-formulated preventive spray under operational conditions. Lindane, used at its registered rate of 1.3%, will be applied to alternate blocks and will be used as a comparable standard for the Sevin spray. The criteria for success of both chemicals will strictly be the protection of treated lodgepole pine against attack by the mountain pine beetle.

An additional purpose of the test will be to obtain further cost-effectiveness figures. Under operational conditions, such treatments would likely be conducted in areas where aesthetic values are predominant. That being the case, a true cost-benefit analysis would be difficult. Still, cost data on a per treated tree basis must be obtained to project cost of these protective treatments.

Area

The treatment area will be along the Black Canyon Loop Road north of Big Springs on the Targhee National Forest near Island Park, Idaho (Figure 1). This area is several miles east of the 1976 preventive test site, where trend plot data indicated an attack density by the mountain pine beetle of 21 new attacks per acre in 1976 (Table 1). Aerial survey data from 1976 showed the area near Big Springs not to be as heavily infested as those areas to the south and west, but the infestation is likely moving towards the proposed test site. Knowing that the current infestation has been moving primarily north and west, we believe that beetle populations will be high north of Big Springs in 1977.

Due to the proximity of private ownerships to the proposed treatment area, the Island Park District Ranger's concurrence will be sought in establishing treatment blocks. No treatment activities will be begun before such concurrence is made.

Methods

This pilot test will involve the application of two insecticides to 50 trees per block in a randomized block design. Each block will contain a sub-block of 25 Lindane treated trees separated from a sub-block of 25 Sevin treated trees by a 2-chain untreated strip. Ten of these 50 tree blocks will be so treated. Depending upon available trees, either more blocks or more trees per block may be added.

Statistical Design

The variable to be evaluated will be the arcsin of the percent successfully protected by Sevin as compared to that protected by Lindane. This transformation, developed for binomial proportions, is described by Snedecor and Cochran in Statistical Methods, 6th Edition, page 327 (Jensen, 1977).

The analysis of variance used will be that for randomized blocks in a standard two-way classification. The analysis will be as follows:

<u>Source of Variation</u>	<u>Degrees of Freedom</u>
10 Blocks	9
2 Treatments	1
Error	9

Tree Selection

Within the individual sub-blocks, treatment tree selection will be made according to the following criteria: (1) Each treatment tree will be at least 9.5" dbh. (2) Each will have at least 2 unattacked trees within a radius of 33' to serve as checks. Each check tree must also be at least 9.5" dbh. (3) Each treatment tree will be separated from any other treatment tree by at least 33'. With this design, each treatment plus at

least 2 check trees will represent a "treatment cluster". There would be no maximum number of check trees in an individual cluster. In past tests, the ratio of checks to treatment trees has averaged about 5:1. Also, in this plot design, any single check tree could serve as a check for up to three treatment trees (Figure 2). In addition to the above criteria, trees should be within 200' of a road to facilitate spraying.

The trees will be selected during the latter part of April. In May, these trees will be tagged with numbered aluminum tags prior to spraying.

Chemical Formulation and Application

The insecticides will be mixed daily at the Island Park Ranger Station. The water with which the chemicals are mixed will be measured for pH and, if necessary, buffered to pH 6.0. The mixing tanks will have internal agitators and recirculation systems to keep the chemicals in suspension. At the end of each day's application, any mixtures left in either tank will be dumped at the Island Park sanitary landfill. All materials dumped will be buried. Too, all refuse is covered by normal operations at the landfill. Following dumping, the tanks, pumps, and spray equipment will be flushed with a neutralizing agent. This material also will be dumped at the landfill.

Two portable, pickup-mounted pumps powered by seven horsepower, 4-cycle, gasoline engines will be used to apply the insecticides. Each pump will be equipped with a pressure gauge to regulate pressures. Actual spray application will be done with a standard spray head containing a #4006 Tee-Jet nozzle attached to a 30' telescoping fiberglass pole.

- The insecticide mixtures will be applied to the tree boles to a height of 30' and to the point of runoff. By applying the mixtures in this manner, approximately one gallon of spray will be used per 50 square feet of bole surface. This averages about 2 gallons of spray per tree--depending upon tree diameter.

Safety Equipment

The dermal toxicity of water-based Lindane and Sevin is quite low; however, certain safety precautions must be taken. Each man will wear coveralls, hard hats, face shields, respirators, rubber gloves, and rubber boots while applying the chemicals. Each truck will have a supply of paper towels, clean water, and soap to clean face shields, face, and hands as needed. Coveralls will be worn only once before being laundered.

Insecticides tested

Lindane is a chlorinated hydrocarbon widely used in a number of forestry and agricultural applications. It has been registered for use against the balsam woolly aphid, some wood borers, and some bark beetles to list a few. Though slightly more toxic to mammals and birds than carbaryl,

its toxicity to these animals is regarded as low. When applied at registered levels, it has exhibited no adverse affects on wildlife; nor has it shown any phytotoxic properties. Though persistent in soils--roughly equivalent to BHC, the method of application used in this test minimizes the possibility of environmental damage (Chevron Chemical Company, 1965).

Sevin (carbaryl) a carbamate, has found wide usage against both agricultural and forest pests. It is registered for use against such forest insects as the gypsy moth, tent caterpillars, elm leaf beetle, and spruce budworm. Carbaryl exhibits good residual properties, and has shown only minor phytotoxic reactions in the form of leaf drop on some fruits. At normal dosage rates, it has a very low toxicity to vertebrates. It is, however, quite toxic to non-target insects--especially honeybees (Union Carbide Corp., 1976).

Treatment Evaluation

We will conduct evaluations for treatment effectiveness following beetle flight. Beetle flight is usually from mid-July through mid-August; therefore, evaluation will take place sometime during September, 1977.

Within each treatment sub-block, the evaluation of treatment effectiveness will be based on those treated trees considered to have been subjected to beetle attack. Treated trees will be considered to have been subjected to attack only if: (1) the treated tree is attacked, regardless of the condition of its checks, or (2) the treated tree is not attacked but at least one of the checks in the "treatment cluster" is attacked. Only those treated trees subjected to attack within a sub-block will contribute to the percent successfully protected--which is the variable we will evaluate.

We will consider a tree successfully attacked if, in our judgement, it contains sufficient brood to cause mortality. During the evaluation we will also record strip-attacks, pitchouts, and attacks above spray height. Attacks above 30' will be verified with binoculars.

Since the purpose of this pilot project is to test the effectiveness of Sevin against the standard, Lindane, direct comparison between the two treatments will be made through a standard randomized block analysis. Percent success for Sevin will be analyzed against percent success for Lindane.

In addition, comparisons of brood abundance and activity will be made in the spring of 1978. We will measure number of attacks, gallery length, and brood stage in each tree by removing two 6 x 6 inch bark samples at dbh--one from each of opposite quadrants. If attacks occur above spray height, similar samples will also be taken at the 30' level.

To measure the attack pressure on the stand in the test area, approximately 30 $\frac{1}{2}$ -acre ($\frac{1}{2}$ x 10 chain) trend plots will be established in the surrounding stand. These plots will help us determine the present infestation level and the population trends of the mountain pine beetle

in that area. These plots, established in May and June, 1977, will provide us with green stand data plus infestation densities for 1975 and 1976. Cruised again in September, 1977, they will yield infestation levels for the current year.

As an additional aid in determining insecticidal effects on both the mountain pine beetle and non-target insects, catchment nets will be placed around the lower bole of selected treatment trees. Collections will be labelled, stored in alcohol, and returned to the laboratory for later examination.

Finally, we will obtain data on the length of time treated trees are protected. Those trees successfully protected will be monitored again in the fall of 1978, and possibly 1979. At the same time, the trend plots will also be cruised in 1978 to provide continuing data on beetle activity in the area.

Sequence of Activities

The sequence of activities for this pilot project will proceed according to the following schedule:

Activity	MONTH								
	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT
Planning	77	77							
Tree Selection			77	77					
Treatment				77	77				
Trend Plots				77	77				77,78
Insect Collection						77	77	77	
Evaluation				78				77	77,78

Cost Analysis

Proposed costs for this pilot project can be found in Tables 2, 3, and 4. Precise expenditures will be recorded as the project is conducted so that overall treatment costs as well as costs per tree may be included in the final report.

REFERENCES

- Chevron Chemical Company. 1965. Lindane technical data sheet. 3pp.
- Gibson, K. E. 1977. Results of a pilot study to test the efficacy of three insecticides in preventing attacks by the mountain pine beetle in lodgepole pine. U. S. Forest Service Report. 18pp.
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- Rogers, S. W. 1975. A preliminary anatomical study of the outer tissues of lodgepole pine boles following treatment with fuel oil formulated insecticides. U. S. Forest Service Report. 8pp.
- Union Carbide Corporation. 1976. Sevimol 4 technical data sheet. 4pp.

Table 1. Trend Plot Data in Area of 1976 Preventive Test.

Diameter Class	Attacked Trees Per Acre						Total Dead
	1976 Hits	1976 Strips	1975 Hits	1975 Strips	1974 Hits	Snags	
6	0.10	--	0.50	--	--	--	0.15
7	0.50	--	0.10	--	--	0.20	0.80
8	1.35	0.60	0.80	0.25	0.05	0.75	2.95
9	2.90	1.25	1.00	0.30	0.15	1.50	5.55
10	3.05	0.80	2.45	0.85	0.50	2.35	8.35
11	4.45	1.10	2.65	0.80	0.95	2.25	10.30
12	3.05	0.85	3.90	1.30	1.40	2.70	11.05
13	2.40	0.20	2.90	0.65	1.05	2.80	9.15
14	1.40	0.45	1.75	0.15	0.90	1.60	5.65
15	0.70	--	0.45	0.15	0.45	1.10	2.70
16	0.60	--	0.20	--	0.25	0.40	1.45
17	0.05	--	--	0.50	0.05	0.15	0.25
18	0.05	--	0.05	--	0.20	0.15	0.45
19	--	--	0.05	--	0.10	0.10	0.25
20	0.05	--	--	--	0.10	0.15	0.30
21	--	--	0.10	--	--	--	0.10
22	--	--	0.05	--	--	--	0.05
23	--	--	--	--	--	0.05	0.05
26	--	--	--	--	--	0.05	0.05
Total	20.65	5.25	16.50	4.50	6.15	16.30	59.60
Percent	34.65	--	27.68	--	10.32	27.35	100.00

Table 2. Cost Estimate for Pilot Project - Salaries & Travel

		Fiscal Year						
		1977			1978			
Activity	Manpower <u>1/</u>	Salary	Per Diem	Mileage	Salary	Per Diem	Mileage	Total
Tree Selection	PFT (20 MD)	\$ --	\$460	\$320	--	--	--	\$ 780
	WAE (40 MD)	1440	920	--	--	--	--	2360
Trend Plots (Pre-Spray)	PFT (5 MD)	--	115	80	--	--	--	195
	WAE (15 MD)	540	345	--	--	--	--	885
Treatment	PFT (20 MD)	--	460	320	--	--	--	780
	WAE (60 MD)	2160	1380	640	--	--	--	4180
Insect Collection	WAE (10 MD)	360	--	--	--	--	--	360
Evaluation	PFT (10 MD)	--	230	160	--	230	160	780
	WAE (10 MD)	360	230	--	360	230	--	1180
Trend Plots (Post Spray)	PFT (5 MD)	--	115	80	--	115	80	390
	WAE (5 MD)	180	115	--	180	115	--	590
Total		\$5040	\$4370	\$1600	\$540	\$690	\$240	\$12480
FY Total		\$11010			\$1470			

^{1/} MD = Man Day. WAE Salaries at GS-5 level.

Table 3. Cost Estimate Pilot Project--Equipment and Materials

Insecticides

Sevimol 4	80 gallons at 10.00 gallon	\$ 800.00
Lindane	120 gallons at 14.60 gallon	1752.00
Nutra-Sol	24 lbs at \$2.00/lb.	48.00
		<u>\$2600.00</u>

Equipment

Metal tags & nails (1000)	\$ 150.00
Hard hats - 4 at 3.00 ea.	12.00
Face Shields - at 8.00 ea	32.00
Gloves - 4 pr at \$4/pr	16.00
Tree marking paint - 12 cans at \$1.50/can	18.00
Wooden Stakes - 200 at \$15/100	30.00
Tool bag - 2 at \$6.00 ea	12.00
Screw driver - 4 at 1.00 ea	4.00
Wrench 2 at 1.00 ea	2.00
Pliers 2 at 1.00 ea	1.00
First aid kit 2 at 3.00 ea	6.00
1"x 2"x 4' boards 80 at .25 ea	20.00
Plastic flagging 20 rolls at \$1.00/roll	20.00
Film & Processing - 6 rolls at \$12/roll	72.00
1 gross screw top vials	25.00
1 gallon 95% ETOH	10.00
Misc. Hardware	25.00
	<u>\$ 455.00</u>

Services

Rental of 2 pumps	\$ 750.00
Sno-mobile rental - 2 days at \$20/day	40.00
Laundry - coveralls	50.00
	<u>\$ 840.00</u>
<u>Total</u>	<u>\$3895.00</u>

Table 4. Total Cost Estimate - 1977 Pilot Project

Salaries and Travel	\$12,480.00
Insecticides	2,600.00
Equipment	455.00
Services	<u>840.00</u>
Total	\$16,375.00

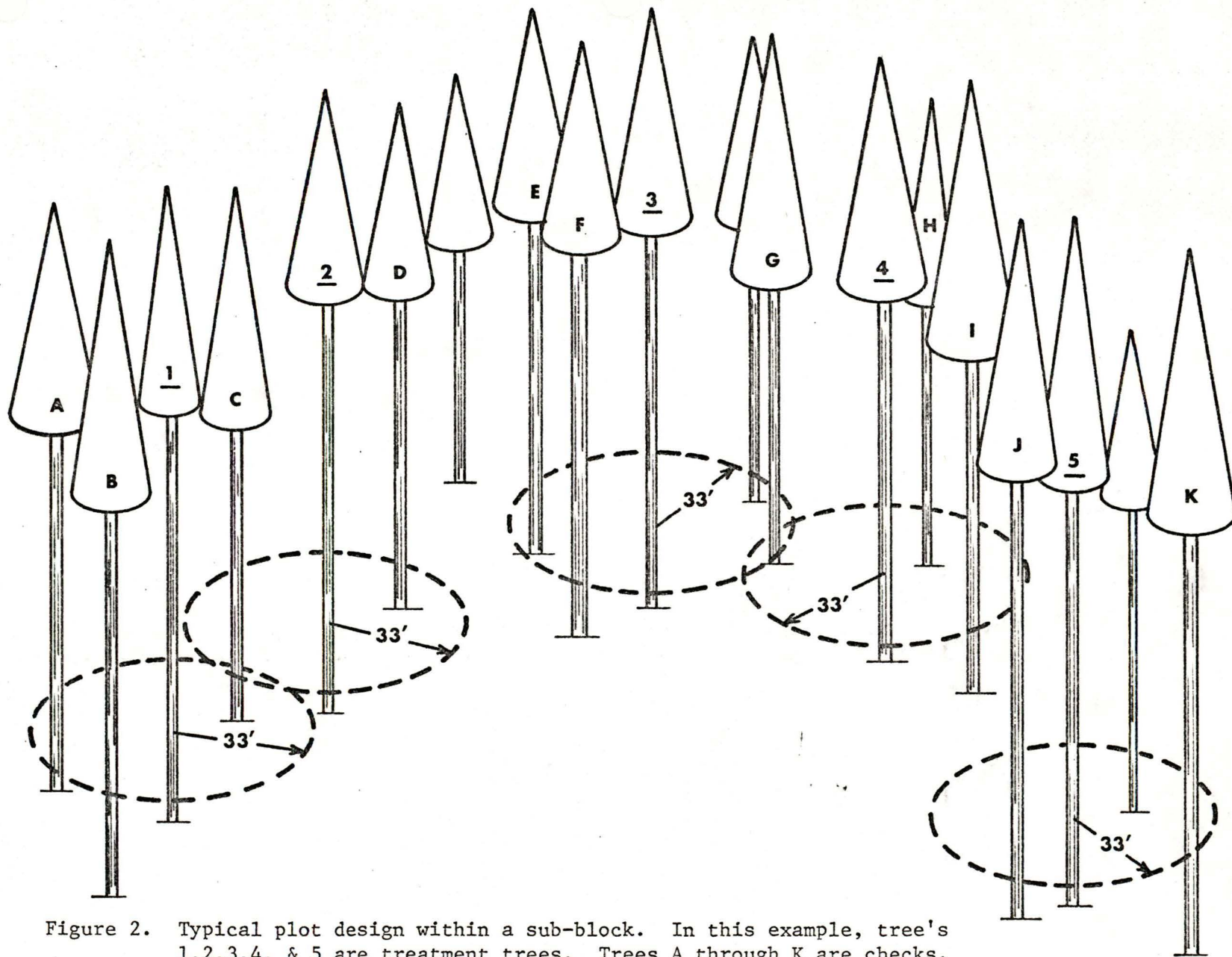


Figure 2. Typical plot design within a sub-block. In this example, tree's 1,2,3,4, & 5 are treatment trees. Trees A through K are checks. Trees C and G are "double checks" since they serve as checks for each of two treatment trees.